A DISSECTION OF THE LARYNX OF A HUMPBACK WHALE CALF WITH A REVIEW OF ITS FUNCTIONAL MORPHOLOGY

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The larynx of a humpback whale calf was dissected. The anatomy conformed with the general mammalian pattern with the addition of a ventral diverticulum. Some thoughts as to how the organ might function are considered. □ *Humpback whale, larynx, anatomy, function.*

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A humpback whale calf (QMJM7303) stranded at Moon Point, Fraser Island, in October, 1989 was frozen soon after death and delivered to the Queensland Museum, Brisbane. It presented an almost unique opportunity to examine a larynx of manageable size with minimal postmortem changes. The calf was 4.2 m long and estimated to be about four weeks old.

The respiratory tract began with two blowholes, slits about 5cm long on each side of the midline and inclined so that their rostral ends were closest together. The blowholes were lined with black skin which continued to the base of the skull where it became continuous with the mucous membrane.

The blowholes were surrounded by fibro-fatty tissue without obvious musculature. From their external entrance the blowholes ran almost horizontally caudally in bony grooves ending as the bony posterior choanae. The vomerine bone of the skull here separated the airway into two channels. The air passage then became a single thin-walled tube which continued, inclined ventrally, to meet the thick-walled muscular oropharynx at an acute angle. This arrangement suggests a valve. This length of tube appeared to be the equivalent of the human nasopharynx.

The larynx itself was horizontally disposed. It measured 20cm from the tip of the epiglottis to the first tracheal ring. Compared with its human counterpart it was in close proximity to the skull base with the tip of the epiglottis extending almost to the posterior choana within the conduit, I have called, the nasopharynx. In this respect elongation of the human pharynges is said to be the result of a vertical stance. The food passage passed on each side of the laryngeal opening as two pyriform fossae to become a single tube, the oesophagus, dorsal to the trachea.

The larynx was a tubular organ with a cartilaginous skeleton. There were three unpaired cartilages, the epiglottic, thyroid and cricoid, and one pair of arytenoid cartilages. Caudally the larynx became continuous with the trachea. The tube was lined with what appeared to be squamous epithelium. This was tough and closely applied particularly over the arytenoid cartilages (compare human vocal cords). The cartilages were joined by muscles most of which could be identified as following the general mammalian pattern.

The thyroid cartilage consisted of two alae or plates continuous in the ventral midline and widely deficient dorsally. There was a small rostral cornua and a long caudal one equivalent to the greater cornua of the human thyroid cartilage. The latter articulated with the cricoid cartilage on each side. There was a flat ovoid facet contiguous on each cartilage and the joint had a thick fibrous capsular membrane.

The cricoid cartilage was complete dorsally where it formed a large rectangular plate 18x12cm. It was deficient ventrally (Fig.1). The dorsal plate merged with the upper tracheal rings forming a substantial crico-tracheal plate. Caudally and laterally was the facet for articulation with the greater cornu of the thyroid cartilage. On each rostral shoulder was a large synovial joint articulating with its respective arytenoid cartilage. The lateral plates of the cricoid were narrow rostrally and broad caudally. Within the ventral deficiency lay the ventral diverticulum. A very thick band of muscle, largely transversally disposed (the thyroarytenoid muscle) filled the space between the lateral alae and covered the diverticulum.

Each arytenoid was complex in shape articulating with the cricoid cartilage as described.

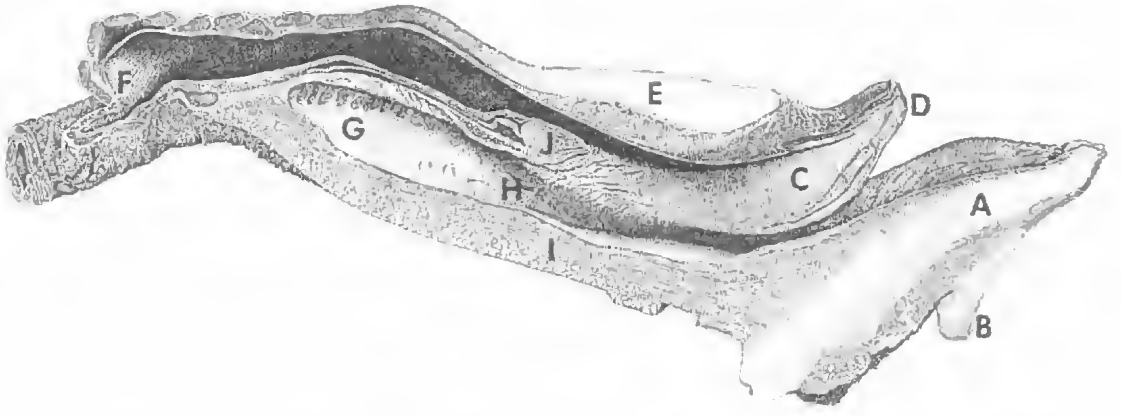

FIG. 1. Longitudinal section of Humpback Whale larynx (JM7303) in medial aspect (thyroid cartilage removed). (A) epiglottic cartilage; (B) fibrous attachment to thyroid cartilage; (C) arytenoid cartilage - corpus; (D) arytenoid cartilage - rostral end; (E) cricoid cartilage; (F) tracheal lumen; (G) fundus of the ventral diverticulum; (H) neck of the ventral diverticulum; (I) thyroarytenoid muscle; (J) interarytenoid fibro elastic connection.

The body of the arytenoid lay largely within the arch of the cricoid. A short thick process extended from the cricoarytenoid articulation to join the body of the cartilage in its middle third. The body was a banana shaped mass 15cm long with the rostral and the caudal extensions. Caudal processes were connected in the midline by a thick fibro-elastic band. The beak shaped rostral processes were concave ventrally and together were almost embraced by the epiglottis. The epiglottis together with the rostral processes of the arytenoids and the aryepiglottic folds formed the arytenoepiglottideal tube. The medial borders of the corpus were almost flat and covered with tough skin. They approximated in the midline. Some accounts refer to part of this body as the cuneiform cartilage (Hosokawa, 1950:28). A partial cleft in this specimen suggests that the cuneiform and arytenoid cartilages may be fused, the rostral process representing the cuneiform cartilage.

The epiglottis was 15 cm long and roughly spoon-shaped concave dorsally. It was relatively elastic and attached by a thick fibrous band to the thyroid cartilage near its cranial notch. The integument on the luminal side had thick longitudinal grooves which seemed almost to interdigitate with those on the adjacent surface of the arytenoid.

The trachea was comparatively short being approximately 4cm long from the cricoid plate to the bifurcation. Dorsally the proximal cartilages were not fused but "jumbled". The cartilages were deficient ventrally where they had rounded ends. The ventral diverticulum was recessed into the defect between these ends, the tracheal lumen being effectively divided into two passages.

A pouch (ventral diverticulum) opened into the laryngeal lumen by a longitudinal slit on its floor between the medial borders of the arytenoid cartilages. There is no human counterpart. It was 10cm long and was 3 cm in diameter at the fundus. The wall was fibrous and appeared nondistensible. There were some shallow pockets in the fundus and the whole was covered by a thick muscular mass. The fundus invaginated into the tracheal lumen on its ventral side and appeared to all but obliterate that lumen.

INTERPRETATION

1, the aryteno epiglottideal tube appeared to form a conduit to carry the air stream from the posterior choanae to the laryngeal inlet.

2, the airstream appeared to be directed into the ventral diverticulum (Fig. 2). The opening into the diverticulum may well be closed during normal inspiration.

3, air passing into the trachea must pass between the flattened margins of the bodies of the adjacent arytenoid cartilages.

4, the ventral diverticulum seemed unlikely to

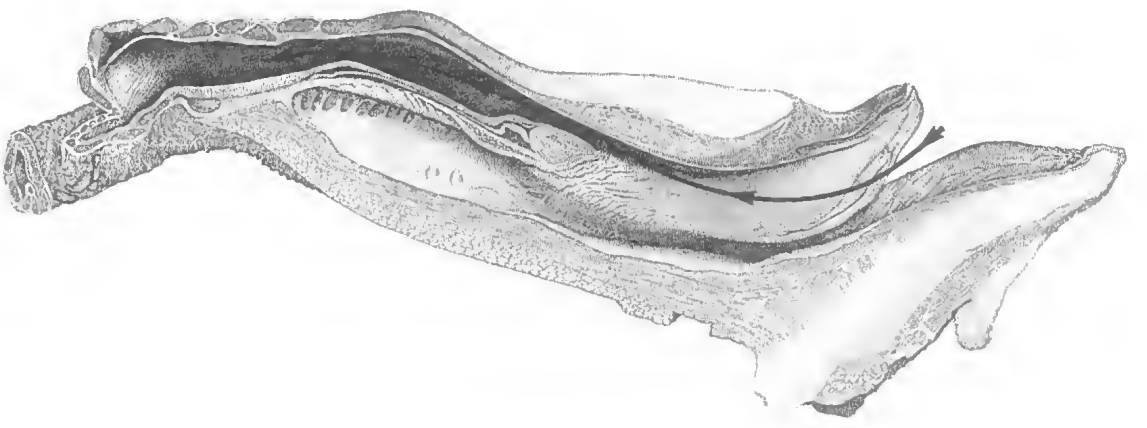

FIG. 2. Longitudinal section of Humpback Whale larynx (JM7303) in medial aspect to show course of air stream into trachea.

be distensible and as a reservoir would have been of relatively small size.

5, air expelled from the diverticulum would apparently pass over the free margins of the arytenoids and through the arytenoepiglottideal tube into the nasopharynx.

6, the ventral diverticulum could apparently function as a valve able to isolate the supraglottic air space from that in the thorax.

7, among cetaceans ventral diverticula have been described only in baleen whales (Slijper,1962:147).

8, baleen whales produce sounds organised into a complex form and distinct from the repeti-

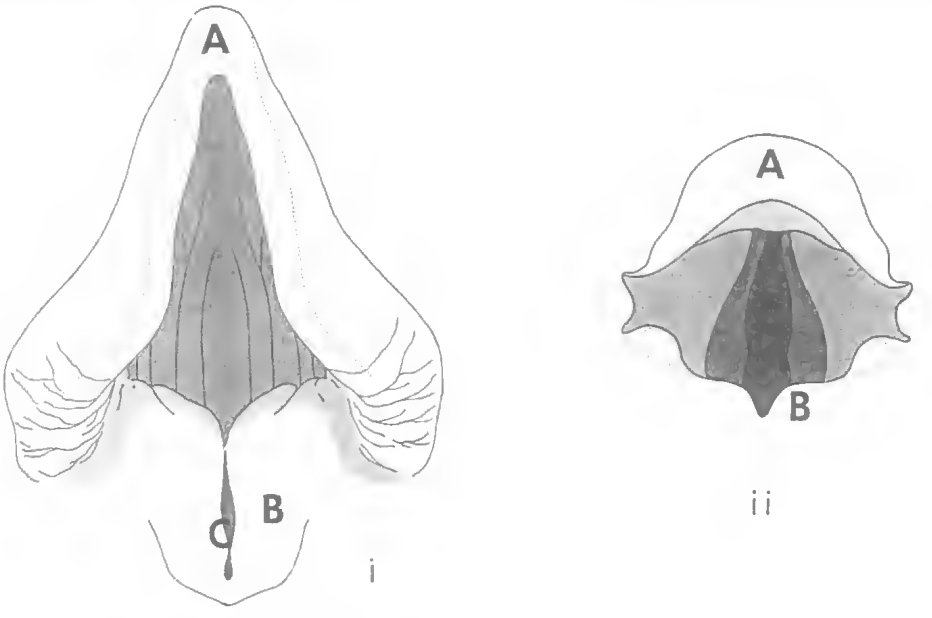

FIG. 3. Schematic drawing laryngeal inlet (i) humpback whale; (ii) human. (A) epiglottis; (B) arytenoid; (C) glottic chink.